Workstation Virtualization Software Review

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Abstract

Performance Benchmarking of PC Virtualization Software. MATT SMITH (Big Bend Community College, Moses Lake, WA 98837 CHARLIE VERBOOM (Lawrence Berkeley National Laboratory, Berkeley, CA 94720

Workstation virtualization software allows one physical workstation (desktop or laptop) to host several different operating systems at the same time. Reduced power consumption, testing of software on different operating systems, and easier migration to new operating systems are a few of the benefits of virtualization. The summer research involved a performance comparison of three different workstation virtualization applications: Microsoft VirtualPC 2007, Parallels Workstation 2.2, and VMware Workstation 6.0. Performance was tested using Passmark Performancetest 6.1, a commercially available performance benchmarking product. The tests were all done on the same computer. Initially, Windows Vista Business 32bit was used as the host operating system. The virtualization application to be tested was then installed on the computer and Windows XP Pro was installed as a guest operating system. Passmark Performancetest was installed, the performance results were taken, and the process was repeated with each virtualization application. The process was repeated with Windows XP Pro as the host operating system in order to measure differences in performance between Windows XP and Vista. All products except Microsoft VirtualPC performed much better with Windows XP as the host operating system than with Windows Vista. Parallels Workstation was the leader of the VM applications in all performance tests. VMware and VirtualPC came in second and third, with VMware performing better with Windows XP as the host and VirtualPC performing better with Vista as the host. The results for VMware may be suspect, as there was a unique problem experienced with that application. When the application was run right after the host machine was restarted, it would perform well. However, when the Virtual machine was closed and reopened without restarting the host, the performance became so bad that the application was unusable. All manufacturers' instructions were followed when setting up the application. This problem was reproducible on a different computer with the same motherboard. For a research institution such as Lawrence Berkeley National Laboratories, the author would recommend Parallels 2.2 as a virtualization application due to it's performance, multiple operating system support, and relatively low cost.

Introduction

Computer virtualization software is a type of program that enables one computer to host multiple operating systems at the same time [1]. The software replaces the computer's drivers with its own, and creates 'virtual' hardware to run with those drivers. The Virtual machine (VM) will use whatever hardware that is allocated to it. This virtual set of hardware is isolated from both the host computer and from other virtual computers. Running separate operating systems on each machine will not disturb the VMs or the host operating system.

The main components of a virtualized machine are the host machine, the virtualization software, and the guest machine. The host machine is the computer which the VM software is installed on. The virtualization software allows a guest, or "virtual", machine to be run. There are two major types of virtualization software: Application based and Hypervisor based. An application based VM runs within the operating system environment of the host computer like any other piece of software. A hypervisor based VM application creates its own small 'operating system' and runs the virtual machine within that rather than the host operating system [2]. Although server virtualization has been successfully implemented since the mid 1990s, workstation virtualization has not been as widely adopted. The main concern when deciding to implement virtualization on their workstations is performance. A server typically has much faster hardware to handle multitudes of data requests from computers on a network. A workstation or desktop computer, however, is made for a single user, and until recently with the evolution of faster CPUs and larger hard drives did not have the power to host more than one operating system. The main benefits to workstation virtualization generally involve areas that do not need maximum performance such as software development, helpdesk usage, and office use where multiple operating systems are in use.

In the last few years, three names have surfaced in the world of virtualization software: Microsoft VirtualPC, VMware Workstation, and Parallels Workstation. These are the three most widely used workstation virtualization programs. This research will evaluate these virtualization solutions in the areas of performance, ease of use, ease of setup, and differences in hardware/software support.

Materials and Methods

To achieve consistency, computers with similar hardware specifications were used in testing. If different computer hardware had been used for performance testing with each VM application, then the results would end up being a measure of the computer hardware's speed rather than the interface speed of the virtual machines.

The computers used in the testing were the Dell Optiplex 745 in a Small form factor case and the Dell Optiplex 745 in a Minitower form factor case. Both of these computers have identical hardware specifications (table 1). Microsoft Windows XP PRO 32-bit was installed as the host operating system on the small form factor machine. Microsoft Windows Vista Business 32-bit edition was installed on the Mini tower machine. Microsoft Windows XP Pro 32-bit edition was used as a guest operating system when evaluating performance, as not all of the virtualization software fully supports Microsoft Windows Vista as a guest operating system. Microsoft Windows Vista business 32-bit edition was used as a guest operating system only to evaluate features of different VM software, where operating system support was a major feature.

The VM applications tested were VMware workstation 6.0, Parallels Workstation 2.2, and Microsoft VirtualPC 2007. These applications all allow multiple operating systems to be run

at the same time on one single physical computer, without the need to reboot to change between operating systems. They are all intended for use by either home users or IT professionals. These virtual machine applications all support a wide range of host operating systems, guest operating systems, and system hardware.

VMware workstation and Microsoft VirtualPC allow separate operating systems to be run as applications within the Host computer's operating system. Parallels Workstation creates its own very small operating system, or 'hypervisor', at the driver level [2]. The virtual machine is then run within this small operating system. While these are two different ways of hosting a virtual machine, the products compete against each other in the same market.

The host computers were optimized for performance in accordance with the VM application manufacturers' recommendations [3]. The virtual machine applications were then installed on the host computer. When the virtual machines were created on each application, similar configurations were used. All of the virtual machines were configured to use both cores of the dual core processor, and were each given 20 GB of hard drive space. They were also set to use the maximum amount of RAM recommended, which was different for each virtual machine application. Microsoft VirtualPC used 1.39 GB of RAM, VMware Workstation used 1.5 GB of RAM, and VMware Workstation used 1.76 GB of RAM.

Passmark Performancetest 6.1 was used to measure the performance of the host and guest machines [4]. This program is a commercial performance benchmarking tool that measures the computer's performance in a number of areas. This benchmarking tool was chosen because of its wide range of performance measurements. Passmark Performancetest acquires results from 27 different tests and averages the results into six major categories of performance: CPU speed, Memory accessing, 2D Graphics, HDD access, CD/DVD accessing, and 3D graphics (not used

in these tests, as the virtual machine software does not support 3D graphics). The application

then averages all of these scores into the "Passmark Rating", which is used as a general rating of

performance.

Results

Host operating systems:

Studies using Windows Vista as the host operating system revealed a large performance penalty

compared to Windows XP as the host operating system, especially in the area of 2D graphical

performance (Figure 2). Windows XP was also marginally better when reading from and writing

to RAM.

Vm applications:

Parallels: Parallels Workstation was the leader in the benchmarking performance tests and in

some areas even outscored the host operating systems. Parallels support 24 different operating

systems [5]. The author did not see a mention of 64 bit operating system support, so it is assumed

that only 32 bit operating systems are supported at the time. Parallels uses a shared folder to

transfer files between the guest and host operating systems. While this is not hard to set up, it is

not as convenient as being able to drag and drop or copy and paste. Parallels offers full support

for Intel VT technology [6] to aid in virtualization. Parallels supports multiple USB devices;

however, USB 2.0 was not mentioned in documentation. Parallels for Windows can be purchased

for $49

Microsoft VirtualPC 2007: The performance of Microsoft VirtualPC was relatively good, except when using Windows XP as the host operating system. When using Windows Vista as the host operating system, VirtualPC overall performance was nearly on par with Parallels'. The disk read/write scores and 2D graphics, however, were significantly lower when using Windows XP. Microsoft VirtualPC supports 10 guest operating systems and 7 host operating systems [7]. Microsoft declares support for 2 64 bit host operating systems: Windows server 2003 x64 standard edition and 64 bit versions of Windows Vista. VirtualPC does not support USB devices. It can either use a network shared folder to transfer files from guest to host and vise versa, or it is possible to drag and drop files between host and guest. VirtualPC will run on a multiprocessor computer, but will only utilize one processor. Support for Intel VT technology or AMD SVM technology was not mentioned in product documentation. Microsoft VirtualPC is available for free.

VMware workstation: The author's initial research with VMware workstation was likely flawed. The VMware based virtual machine worked well right after a restart of the physical machine, which is when the benchmark tests where done. When the virtual machine was restarted, without restarting the physical machine, extreme slowness was experienced regardless of the guest or host operating system used. When VMware workstation was installed on a computer with the same specifications as the research computers (except for integrated rather than dedicated graphics, and a different motherboard design) the problem went away. Vmware's performance, however, was not measured on the new machine. The process of the performance tests was performed correctly according to manufacturer's recommendations [3] however; the

results may be inaccurate if the measurements taken immediately after a reboot were not correct. VMware performed slowly with Windows Vista as the host operating system. The performance with Windows XP as the host was significantly better in all areas, although still not as fast as Parallels. VMware supports the largest number of guest and host operating systems (29 16bit/32 bit and 10 64 bit as guest, 49 16bit/32bit and 30 64bit as host.) [8]. VMware supports multiple USB 2.0 devices, multiple monitors, and up to 2 CPUs per virtual machine. VMware also includes specialized software for debugging applications within virtual machines. VMware workstation for Windows is available for $189.

Discussion/conclusions

Operating systems:

All virtualization products performed slower with Windows Vista as a host operating system than with Windows XP (figure 1). VMware and Parallels performed significantly better with Windows XP as the host operating system. Microsoft VirtualPC performed only marginally better with XP as the host than it did with Windows Vista as the host operating system. In the VirtualPC documentation, Microsoft says that VirtualPC 2007 was optimized to work well with Windows Vista [7], and this optimization may have been done at the expense of performance within Windows XP. Windows XP worked much faster overall than Vista as a host operating system. Vista is still a very new operating system, and the drivers may not be ready for virtualization.

Virtualization applications

Parallels:

The Parallels hypervisor offers better performance when compared to the other virtualization tools tested. Parallels' scores on 2D graphical benchmarks (figure 2) were much higher than any of the other virtualizations tools, and in the case of Windows Vista, actually faster than the host operating system. In most areas, other than hard drive access (where it achieved the lowest score), Parallels outperforms the other virtual tools. Parallels uses a slightly slower method of file transfer than the other applications. The Parallels shared folder is relatively easy to set up, but after being spoiled with drag and drop on VMware workstation and VirtualPC, it feels slow. Parallels workstation is most likely the best choice for someone who is using Linux on their home PC or office PC that wants to virtualize a Windows desktop. Parallels supports the most common Linux and Windows operating systems (guests and hosts) and also supports lesser used operating systems such as FreeBSD, OS/2 warp, Sun Solaris, and MS-DOS 6.22 [5]. The operating system support in itself would justify the relatively low $49 price tag when compared to Microsoft VirtualPC. A single version of Parallels for both Windows and Linux makes it much easier to support in a large business than the two different versions of VMware needed for the same operating system support.

Microsoft VirtualPC:

The performance of Microsoft VirtualPC suffered measurably when using a Windows XP host. This is not a significant problem, as most people that use VirtualPC2007 will be using it to virtualize Windows XP, 2000, or 98 guests on a Windows Vista host. While the performance with a Windows Vista host is not the best of the three, it is respectable. VirtualPC 2007 is obviously targeted more at the home user or small business than a large complex business

environment, with only Windows host operating systems supported. Microsoft says that most x86 operating systems will work as a guest with VirtualPC [7], but they do not list support for any in their documentation. No USB support may be a problem for home users if they want to use external storage or an Ipod with their virtual machine. You can, however, just drag and drop files onto the physical machines desktop and then use the physical machine for USB, which is not too much of an inconvenience. VirtualPC is a great free choice for those home or office users who want to virtualize older Windows operating systems on their Windows Vista based machine. If the user is going to virtualize a Linux or Solaris or any other x86 desktop, however, Parallels would be the better choice, because Parallels offers support for these operating systems.

VMware workstation:

With Windows Vista as a host operating system, VMware was outperformed by both of the other products in every test performed. This may seem significant, but the other products did not perform very well either. With Windows XP as a host operating system, VMware nearly equaled the performance of Parallels, and exceeded the performance of VirtualPC. Vmware's cost of $189 keeps this product from being a good idea for the home user. Many features such as multiple NIC support, multiple monitor support, a built in DHCP server, application debugging tools, and support for USB 2.0 [9] make the software worth the money for specialized business applications where they would be using more of the advanced features features.

Acknowledgements

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[9] VMware overview
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Tables

Table 1- specifications of host machine

Physical Machine Specifications		
Motherboard:	Dell motherboard with Intel 965 Extreme chipset	
CPU:	Intel Core2 6400 2.13 GHz	Intel VT Technology enabled
RAM:	2.0gb non ECC SDRAM (667 MHz)	
Hard Drive:	160gb SATA 3.0	
CD/DVD:	8x CD/DVD +/- RW	
Video:	PCI-Express Radeon 1300 256 MB DVI/VGA	

Figure 1- Performance scores of VM applications and host computers
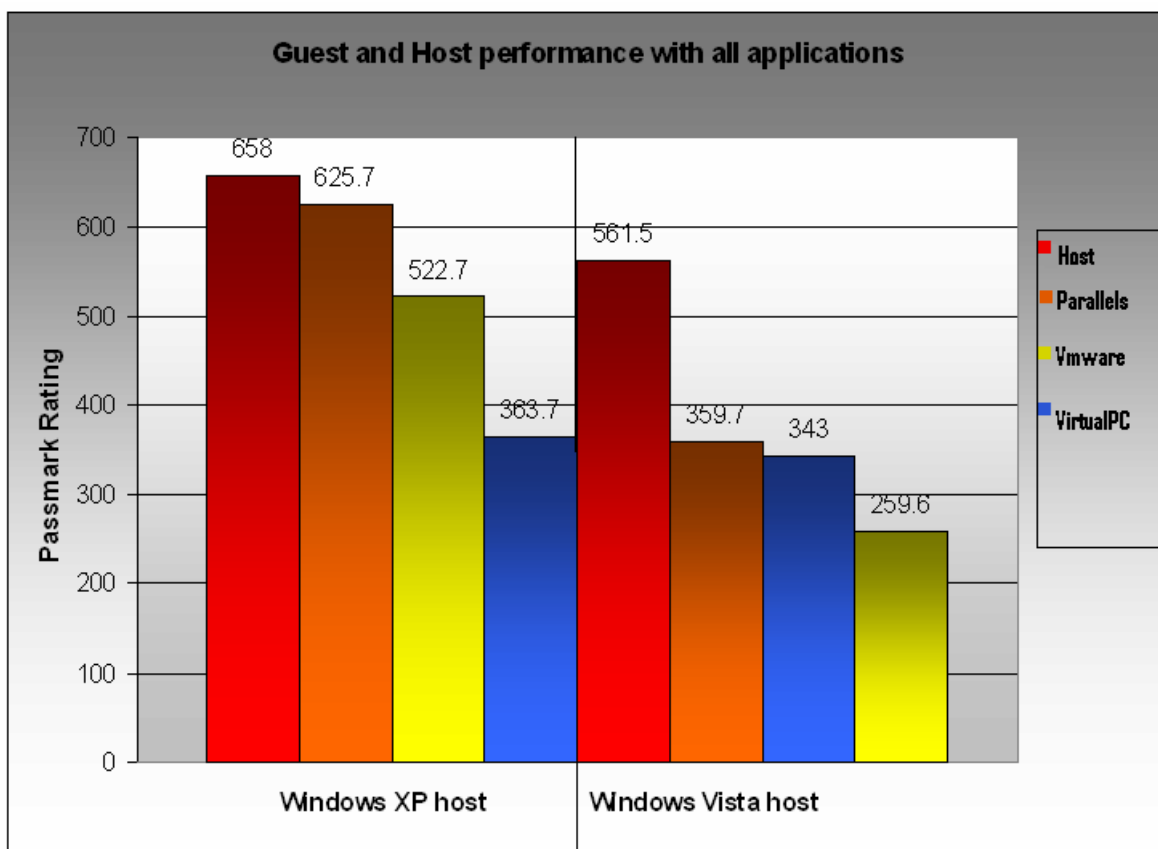
Figure 2- Results from 2D graphics benchmarks (graphical user interface)